編號： 136 國立成功大學 107 學年度碩士班招生考試試題

系　所：航空太空工程學系

考試科目：材料力學 考試日期：0205，節次：1

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※ 考生請注意：本試題不可使用計算機。 請於答案卷(卡)作答，於本試題紙上作答者，不予計分。

1. (30%) A propped cantilever beam of length L is loaded by a triangularly distributed load of maximum intensity q_0 at B as shown in Fig. 1. The beam has a rectangular cross section with width b and height h.
   (a) Use the fourth-order differential equation of the deflection curve to solve for reactions at A and B and also the equation of the deflection curve.
   (b) Determine the strain energy U stored in the beam.
   (c) Calculate the bending stress σ_x at the top surface of the fixed end A.
   (d) Calculate the maximum shear stress τ_{xy} at the mid-point ($x = L/2$) of the beam.

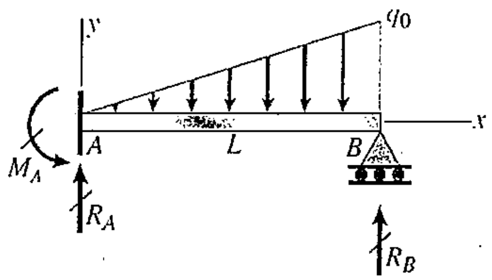

Fig. 1

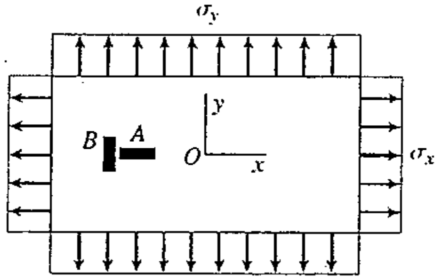

Fig. 2

2. (20%) A rectangular steel plate with thickness $t = 6.0$ mm is subjected to uniform normal stresses σ_x and σ_y, as shown in Fig. 2. Strain gages A and B, oriented in the x and y directions, respectively, are attached to the plate. The gage readings give normal strains $\varepsilon_x = 0.00062$ (elongation) and $\varepsilon_y = -0.00045$ (shortening). The Young's modulus and Poisson's ratio of the steel are, respectively, $E = 200$ GPa and $\nu = 0.3$.
   (a) Determine the stresses σ_x and σ_y and the change Δt in the thickness of the plate.
   (b) Determine the principal stresses and show them on a sketch of a properly oriented element.
   (c) Determine the maximum shear stresses and associated normal stresses and show them on a sketch of a properly oriented element.

3. (25%) A prismatic bar BC, with cross-sectional area A, is loaded by a uniformly distributed axial load p from the mid-span at D to end C as shown in Fig. 3. Young's modulus of the material is E. Determine the displacements (a) of point D and (b) of point C.

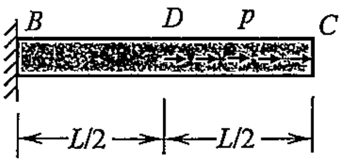

Fig. 3

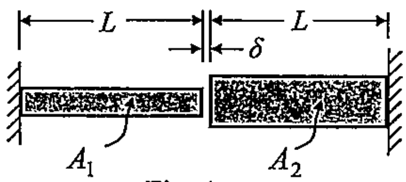

Fig. 4

4. (25%) Two bars of the same material are arranged so that the gap between their free ends is $\delta = 0.20$ mm at room temperature (see Fig. 4). The length of bars is $L = 100$ mm; cross-sectional areas are $A_1 = 125\ \text{mm}^2$ and $A_2 = 250\ \text{mm}^2$. Young's modulus of the material is $E = 200 \times 10^6$ Pa, and the coefficient of thermal expansion is $\alpha = 10 \times 10^{-6}/°\text{C}$. Calculate the stresses in the two bars when the temperature increase is $300°\text{C}$.